Very Clean Epitaxial Superconducting MgB_2 Films

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In collaboration with Prof. Xiaoxing Xi and Joan Redwing at Penn State, epitaxial thin films of MgB_2 have been achieved using a hybrid physical-chemical vapor deposition. The thin films represent the cleanest form of MgB_2 so far reported with the electron mean free path of ~ 6000 Å and superconducting T_c ~ 41 K. In comparison, T_c of single crystals and bulk materials are ~ 39 K. The critical current density J_c at zero magnetic field at 4.2 K reaches ~ 10^8 A/cm^2 close to the depairing current limit. The magnetic field dependence of the J_c is shown in the figure.

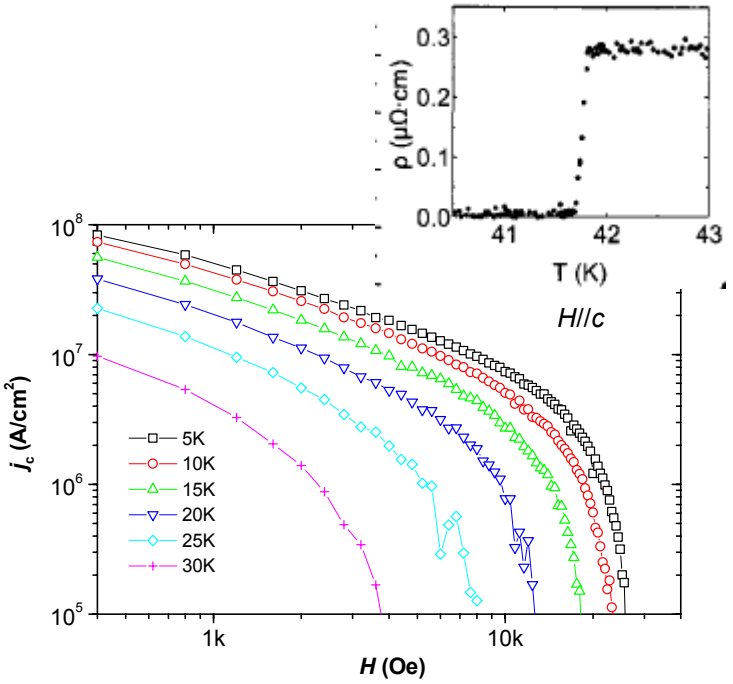

Fig. 1. Critical current density as a function of magnetic field for different temperatures. Inset: Resistivity vs. temperature curve.

Spin-Injection in Heterostructures of Perovskite Oxides

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Education:

Two undergraduates (Ricky O'Haire and Julia Liu), two graduate students (Eric Wertz and Yufeng Hu), and one postdocs (Ben Xu) participated in this research. Julia Liu joined my group as a freshman undergraduate. The purpose of having undergraduate female students to conduct research in early year of their college study is to improve the retention of female students in Science and Engineering.

In the news:

Our paper on MgB_2 published in Nature Materials 1, 35 (2002) have cited in various news articles in different countries including New York Times and Scientific American.

Reproduced from New York Times, Sept. 3, 2002

Dr. Qi Li/Pennsylvania State University

A thin film of magnesium diboride grown by Penn State researchers is pure and smooth enough to be used in future electronic devices. The bumps are only a few 10-millionths of an inch high.